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STANDARDIZATION OF ACCELERATED AGEING DURATION TO EVALUATE SEED STORABILITY OF SOYBEAN CULTIVARS

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ABSTRACT

Storability of soybean seed is poor as compared to other oil seed crops due to its inherent seed structure and composition. Hence, the maintenance of seed viability with prescribed germination from harvest till next sowing is a great challenge. Seeds of different varieties of same species vary in rate of ageing which decides their storability. Accelerated ageing test is one of the most successful tests for evaluation of seed vigor and has good correlation with field emergence and storage potential of the seed. The duration of accelerated ageing, time taken to reduce the germination potential to 50% of the initial, varies with varieties produced in the same climatic condition mainly due to genetic nature. In this context, an attempt was made to standardize the ageing duration to screen the cultivars for storability. Significant decline in the germination and seedling vigour in all the cultivars was observed with the advancement of ageing duration. But, the rate of reduction in germination was varied among cultivars which is highest in NRC 93 followed by MAU 61 and lowest in EC 18761 which is on par with CO1. Germination per cent was reduced to 50 per cent of the initial by 4 days in NRC 93 and MAUS 61 whereas 5 days in DSB 24 and 7 days in CO 2, CO 1, KBS 22-2009 and EC18761. Thus, seed germination of most of the tested cultivars was reduced to around 50 per cent of the initial by 7 days of accelerated ageing. Hence, 7 days of accelerated ageing would be optimum duration to screen the cultivars for seed storability in soybean.

KEYWORDS: Accelerated Ageing, Seed Germination, Soybean, Storability

INTRODUCTION

Soybean (*Glycine max* L.) is an important protein rich oilseed crop widely grown in tropical, sub-tropical as well as temperate region. Globally, soybean is being grown in an area of 102 m.ha of which 90 per cent is concentrated in US, Brazil, Argentina, China and India. During 2012-13, 276 m. tonnes of soybean was produced worldwide with a productivity of 2474 kg/ha (FAOSTAT, 2013). In India, soybean was grown in an area of 12.2 m.ha with a production of 11.99 m. tonnes and productivity of 983 kg/ha during 2013-14 (Agricultural Statistics at a Glance, 2014)

Soybean seeds storage is big challenge to seed industry as seeds loses viability below minimum seed certification standard before next growing season due to its inherent seed structure and composition. Because of this, there is problem of non-availability of high vigour and viable seeds at the time of sowing which finally leads to poor field stand, productivity and production.

Biochemical changes occurring in seed during ageing play an important role in seed longevity. The rate at which the seed ageing process takes place depends on the ability of seed to resist degradation changes and protection mechanisms, specific for each plant species and even specific to varieties. So, the seeds of different varieties of same species vary in speed of ageing which decides their storability. Accelerated ageing test is widely used test for evaluation of seed vigor and it has good correlation to field emergence and storage potential of the seed. In order to evaluate the storage

potential of different varieties, accelerated ageing test is being employed especially in soybean.

International Seed Testing Association (ISTA) has standardized accelerated ageing period of three days for evaluating vigour potential of a seed lot (ISTA, 2007), while the results of national network project of AICRP (NSP)-crops recommended four days (Ten years Research highlights of AICRP (NSP)-Crops, 2009). We have assumed that period of accelerated ageing, in which the germination is reduced to 50 per cent of the initial, will be correct duration for screening the cultivars for seed storability. In this context, an attempt was done to standardize the ageing period to screen the cultivars for storability.

MATERIALS AND METHODS

The seeds of one soybean genotype EC18761 and 6 cultivars *viz.*, CO1, CO2, KBS 22-2009, DSB 24, MAUS 61 and NRC 93, multiplied in Agricultural Research Station of Tamil Nadu Agricultural University, Bhavanisagar during *kharif*, 2014 were used in this study. Fourty gram of fresh seeds having moisture content of 8.5% were subjected to accelerated ageing for the period of 3, 4, 5, 6, 7 and 8 days. Seeds were packed in paper bag with uniform pin head size perforation all over and placed in a sealed ageing glass jar containing 250 ml of distilled water to maintain 100 per cent relative humidity and incubated at a temperature of 40 ± 1° C. Separate glass jars were used for each ageing period containing seeds of all seven cultivars. After the each ageing period, seeds were taken out and tested for following seed quality parameters along with unaged seed.

Seed Germination Percent

The laboratory germination test was carried out using 100 seeds of four replication in paper medium (ISTA, 2007). The test conditions of 25 ± 2°C temperature and 95 ± 3 per cent relative humidity were maintained in the germination room. At the end of eight days, number of normal seedlings was counted and the mean was expressed as germination per cent.

Shoot Length

Shoot length of ten normal seedlings from each replication of the germination test was measured from collar region to the shoot apex and the mean was expressed in centimeter.

Root Length

Root length of ten normal seedlings from each replication of the germination test was measured from collar region to the root tip and the mean was expressed in centimeter.

Vigour Index I

Vigour index I values were computed using the following formula as suggested by Abdul-Baki and Anderson (1973) and the mean values were expressed in whole number.

Vigour index I = Germination (%) x Total seedling length (cm)

RESULTS AND DISCUSSIONS

Seeds of seven cultivars undergone accelerated ageing shown significant variation in ability to germinate and seedling vigour.

Seed Germination

Initial seed germination varied with the cultivars tested, maximum of 99 per cent of seed germination in EC 18761 and minimum of 87 per cent was noticed in NRC 93. There was a significant decline in seed germination of all the cultivars with the advancement of ageing. However, the rate of reduction in germination was varied significantly among cultivars which is high in NRC 93 followed by MAUS 61 and DSB 24 and lowest in EC 18761 which is on par with CO1 followed by KBS 22-2009. The highest reduction in seed germination was observed in NRC 93 with 36, 58, 73, 82, 95 and 98 per cent of the initial seed germination, at 3, 4, 5, 6, 7 and 8 days after accelerated ageing and could give only 1 per cent seed germination after 8 days of accelerated ageing whereas minimum reduction of germination was noticed in EC18761 which recorded 3, 3, 25, 34, 46 and 54 per cent reduction after the same ageing periods and maintained 45 per cent of germination after 8 days of accelerated ageing (Table 1).

Seed germination per cent was significantly varied among ageing periods with 14, 31, 42, 54, 68 and 76 per cent after 3, 4, 5, 6, 7 and 8 days of ageing. Seed germination per cent was reduced to 50 per cent of the initial by 4 days in NRC 93 and MAUS 61 whereas 5 days in DSB 24 and 7 days in CO 2, CO 1, KBS 22-2009 and EC18761. Kuchlan *et. al.,* 2010 reported that accelerated ageing for 4 days decreased seed germination significantly in all 15 cultivars tested and the range was 50-94 per cent. However, germination per cent fallen below minimum seed certification standards of 70 per cent at 8 days of ageing in all the cultivars except Bragg, JS 9305, PS 1024 and MAUS 612.

Seed deterioration, especially in oilseeds, is due to lipid peroxidation as it will leads to production of free radicals which cause damage to enzymes that are necessary to convert reserve food in the embryo to usable form and ultimately production of normal seedling (Iqbal *et al.*, 2002). The free radicals generated during lipid peroxidation also degrade mitochondrial membrane leading to reduction in energy supply necessary for germination thereby cause failure in seed germination (Gidrol *et al.,* 1998).

In our study, cultivars tested showed varied capability to withstand accelerated ageing and produce normal seedling which might be due to difference in their resistance to deteriorative changes occurring in seed during aging. Several factors are responsible for the cultivars' difference in tolerance to the changes during ageing and few important factors are varied seed coat characteristics, chemical composition and anti-oxidative ability of seeds of cultivars.

Shoot and Root length

Initial shoot length was ranged from 17.6 to 20.7cm whereas root length was varied from 19.7 to 23.9 cm. The ability to produce vigorous shoot and roots declined over the ageing period. The reduction was gradual in EC18761, KBS 22-2009 and CO1 whereas it was drastic in NRC 93, MAUS 61, DSB 24 and CO2. The lowest reduction was noticed in EC 18761 which maintained shoot length of 12.7cm and root length of 11.6cm after 8 days of accelerated ageing, followed by CO1 and KBS 22-2009 while highest reduction was recorded in NRC 93 which could produce shoot and root length of 8.3 and 8 cm, respectively (Table 2 & 3) followed by MAUS 61, DSB 24 and CO2. The seed deterioration had led to reduced seedling growth as a consequence of both lower respiration and reduced mitochondria in cells (McDonald, 1999) and accelerated aging test is characterized by the loss of germination and poor seedling development (Mosavi *et al.*, 2011).

Vigour Index

A significant difference among the cultivars was observed with respect to decline of vigour index. The decline

was slower in EC18761, KBS 22-2009 and CO1 and it was very fast in NRC 93 followed by MAUS 61 and DSB 24. The decreased seed vigour is because of reduced capacity to germinate and produce vigorous seedlings which might be due to seed deterioration resulting from accelerated ageing of seed (Singh, 1989). Accelerated ageing of seed, i.e., exposure of seeds to high temperature and high relative humidity leads to the loss of vigour and eventually viability, and it is an excellent method to determine the vigour changes during seed storage (Tian *et al.* 2008).

CONCLUSIONS

The study revealed that cultivars differed in ability to germinate and produce vigorous seedlings during the accelerated ageing might be due to varied capability of cultivars to resist deteriorative changes during ageing. Out of the seven cultivars tested, seed germination of three cultivars (NRC 93, MAUS 61 and DSB 24) was reduced to below 50 per cent of the initial by 5 days of accelerated ageing whereas in the cultivars *viz.,* CO 2, CO1, KBS 22-2009 and EC18761, seed germination was reduced around 50 per cent of the initial, at the end of seven days of accelerated ageing. Since 7 days of accelerated ageing reduced the seed germination to around 50 per cent of the initial in most of the cultivars tested, accelerated ageing for 7 days would be optimum duration to screen the cultivars for seed storability in soybean.

Table 1: Effect of Accelerated Ageing on Seed Germination Percent in Soybean Cultivars

Cultivars	Initial	Accelerated Ageing Period (Days)						Mean
		3	4	5	6	7	8	
EC 18761	99 (87.1)	96 (80.1)	86 (68.0)	74 (59.3)	65 (53.7)	53 (46.7)	45 (42.1)	**74 (62.46)**
KBS 22-2009	97 (83.1)	95 (77.4)	82 (64.9)	75 (60.0)	62 (51.9)	50 (45.0)	39 (38.6)	**71 (60.1)**
CO 1	93 (74.9)	89 (70.7)	78 (62.0)	72 (58.0)	63 (52.5)	51 (45.5)	40 (39.2)	**69 (57.5)**
CO 2	92 (73.8)	85 (67.2)	70 (56.7)	61 (51.3)	48 (43.8)	34 (35.6)	20 (26.5)	**58 (49.9)**
DSB 24	89 (70.8)	84 (66.4)	57 (49.0)	40 (39.2)	32 (34.4)	12 (20.1)	5 (12.4)	**46 (41.8)**
MAUS 61	95 (77.3)	58 (49.6)	41 (39.8)	30 (33.1)	19 (25.8)	9 (17.3)	3 (9.9)	**36 (36.1)**
NRC 93	87 (68.9)	55 (47.8)	36 (36.8)	23 (28.6)	15 (22.7)	4 (11.2)	1 (5.7)	**32 (31.7)**
Mean	**93 (76.6)**	**80 (65.6)**	**64 (53.1)**	**54 (47.2)**	**43 (40.9)**	**30 (33.2)**	**22 (27.9)**	**55 (47.8)**
Source of Variation			**SEd**			**CD (P=0.05)**		
Variety (V)			0.75			1.49		
Ageing (A)			0.75			1.49		
VxA			2.00			3.95		

() - values in the parenthesis are arc sine transformed values

Table 2: Effect of Accelerated Ageing on Shoot Length (cm) in Soybean Cultivars

Cultivars	Initial	Accelerated Ageing Period (Days)						Mean
		3	4	5	6	7	8	
EC 18761	19.3	19.0	18.7	17.1	15.6	13.5	12.7	**16.5**
KBS 22-2009	20.7	20.1	19.0	17.8	16.0	13.0	12.3	**17.0**
CO 1	19.6	18.7	17.9	16.0	15.6	13.4	12.0	**16.2**
CO 2	17.6	15.3	13.1	12.2	12.0	10.6	9.8	**12.9**
DSB 24	18.5	16.5	14.6	12.1	11.3	9.6	9.0	**13.1**
MAUS 61	18.3	16.2	13.4	12.0	11.3	10.0	8.9	**12.9**
NRC 93	19.4	15.6	13.3	11.1	9.9	9.0	8.3	**12.4**
Mean	**19.0**	**17.3**	**15.7**	**14.0**	**13.1**	**11.2**	**10.4**	**14.4**
Source of Variation			**SEd**			**CD (P=0.05)**		
Variety (V)			0.39			0.77		
Ageing (A)			0.39			0.77		
VxA			1.03			2.04		

Table 3: Effect of Accelerated Ageing on Root Length (cm) in Soybean Cultivars

Cultivars	Initial	Accelerated Ageing Period (Days)						Mean
		3	4	5	6	7	8	
EC 18761	19.7	18.9	18.4	15.5	14.8	14.3	11.6	**16.2**
KBS 22-2009	22.3	21.0	19.1	16.4	15.2	13.9	12.0	**17.1**
CO 1	21.6	18.6	17.2	15.3	14.0	13.4	11.0	**15.9**
CO 2	22.9	17.5	14.3	13.2	12.6	11.2	9.8	**14.5**
DSB 24	23.3	20.2	17.8	15.6	13.4	12.1	10.3	**16.1**
MAUS 61	23.9	19.3	15.5	14.7	13.1	10.0	8.4	**15.0**
NRC 93	20.2	18.1	15.2	12.0	11.4	9.9	8.0	**13.5**
Mean	**21.9**	**19.0**	**16.7**	**14.6**	**13.4**	**12.1**	**10.1**	**15.5**

Source of Variation	SEd	CD (P=0.05)
Variety (V)	040	0.80
Ageing (A)	0.40	0.80
VxA	1.07	2.12

Table 4: Effect of Accelerated Ageing on Vigour Index in Soybean Cultivars

Cultivars	Initial	Accelerated Ageing Period (Days)						Mean
		3	4	5	6	7	8	
EC 18761	3861	3631	3191	2415	1973	1470	1090	**2519**
KBS 22-2009	4165	3905	3122	2569	1933	1343	948	**2569**
CO 1	3828	3315	2738	2257	1863	1368	922	**2327**
CO 2	3727	2782	1918	1549	1181	741	392	**1755**
DSB 24	3713	3087	1844	1105	792	261	96	**1557**
MAUS 61	4009	2056	1186	799	464	180	52	**1250**
NRC 93	3447	1852	1028	531	320	75	16	**1039**
Mean	**3821**	**2947**	**2147**	**1604**	**1218**	**777**	**502**	**1859**

Source of Variation	SEd	CD (P=0.05)
Variety (V)	35.83	70.81
Ageing (A)	35.83	70.81
VxA	94.80	187.35

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